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Interplay between food safety climate, food safety management system and microbiological output in farm butcheries and affiliated butcher shops

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INTRODUCTION

Up to now scientific research focused on analytical methods, food processing technology and product formulations as technological solutions and Food Safety Management Systems (FSMS) as managerial solution to improve the safety status of food products along the food supply chain (Figure 1). However, in practice, a well elaborated and fit-for-purpose FSMS, does not always guarantee the highest level of food safety and hygiene and a stable system output (Jacxsens et al., 2015). Human behavior (e.g. the actual execution of procedures), and decision making is influenced by the perceived food safety climate in an organization (Yiannas, 2009). The aim of this work was to set a definition for food safety culture/climate and to develop and validate a tool to measure the food safety climate in food companies. The terms safety culture and safety climate are often used interchangeably in literature (Wiegmann et al., 2012). In our research food safety climate is considered as a measured perception of the food safety culture present in a company (Table 1). These concepts are further demonstrated via a case study linking food safety culture and microbiological output between micro scale short chain farm butcheries, having a basic FSMS, and large scale centrally managed affiliated butcher shops, having a more fit-for-purpose FSMS.

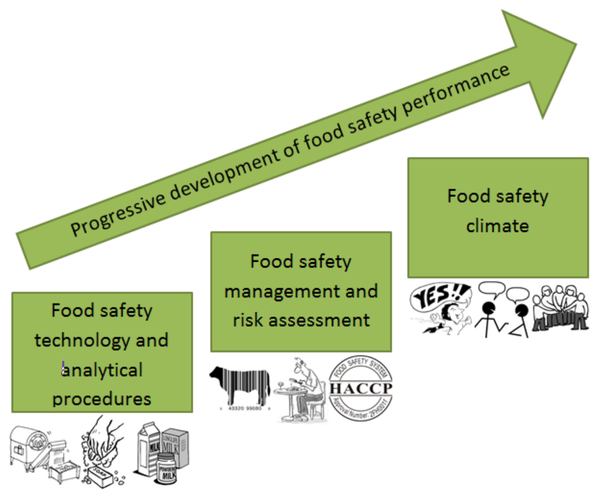

Figure 1: Evolution of research focus towards food safety climate (Wright et al. 2012)

MATERIALS AND METHODS

The development of the food safety climate assessment tool was executed by means of a comprehensive literature study and discussion with experts in the field. Next, twenty other experts with expertise concerning food safety/quality and FSMS, such as governmental agencies (n=4), third party certification bodies (n=3), sector associations (n=3), universities (n=1) and industry (big companies: n=6, small companies: n=3) from Belgium and the Netherlands, were asked to evaluate the relevance and validity of our initial food safety climate assessment tool. For the case study, microbiological samples were taken from raw minced beef meat (n=50) and production environment (food contact surfaces (knives, cutting boards and mincer swabs: n=120; *L. monocytogenes* swabs: n=120) and hands of workers (n=69)) and were analyzed for food safety, hygiene and quality parameters in order to gain information of the actual output of the 8 visited butcheries (4 farm butcheries (FB1-FB4) and 4 affiliated butcher shops (AB1-AB4)). Also, the food safety climate assessment survey was completed by every employee of these companies (n=39).

Table 1: Definitions food safety climate and food safety culture

Food safety climate	Food safety culture
Employees' (shared) perception of the leadership, communication, commitment, resources and risk awareness concerning food safety and hygiene within their current work organization	The interplay of the food safety climate perceived by the employees and the managers of a company (so called *'human route'*) and the context in which a company is operating, the current implemented FSMS, consisting out of control and assurance activities (so called *'techno-managerial route'*) resulting in a certain (microbiological) output

RESULTS

The definitions for food safety climate, food safety culture and the different components are given in Table 1 and Figure 2. A self-assessment survey with 28 indicators was developed and adjusted based on the expert validation (Table 2).

Table 2: Example of an indicator for each component of Food safety climate

Component	Example indicator
Leadership	In my organization, the leaders are able to motivate their employees to work in a hygienic and food safe way.
Communication	In my organization, the leaders communicate in a clear way with the operators about hygiene and food safety.
Commitment	In my organization, employees are actively involved by the leaders in hygiene and food safety related matters.
Resources	In my organization, employees get sufficient time to work in a hygienic and food safe way.
Risk awareness	My colleagues are alert and attentive to potential problems and risks related to hygiene and food safety.

Figure 2: Components of Food safety climate (based on Griffith et al. 2010)

The overall results of the case study in the meat distribution sector are represented in Figure 3. It can be seen that the affiliated butcher shops (n=23) perceived the food safety climate to be on a higher level than the independent short chain farm butcheries (n = 16), a significant difference could be detected between both types of fresh meat selling points (p = 0.046).

Also, it can be noted from Figure 3 that the affiliated butcher shops are able to counter the risky context (high level of risk towards microbiological contamination) by a well elaborated and fit-for-purpose FSMS (high level), whilst the short chain farm butcheries have a more basic FSMS (lower level).

Considering the link between food safety climate, FSMS status and microbiological hygiene and safety status, it can be seen that the affiliated butcher shops have a higher food safety climate score and a more elaborated/fit-for-purpose FSMS, which results in an overall higher microbiological hygiene and safety status than the farm butcheries (except AB4). It isn't clear whether the higher food safety climate or the well elaborated FSMS or their interplay is responsible for this higher hygiene and safety status. The lower food safety climate score and less elaborated/fit-for-purpose FSMS of the farm butcheries is resulting in a high, medium or low hygiene and safety status, as FB1 is ranked relatively high, FB2 is ranked more in the middle and FB4 and FB3 are more on a lower level of microbiological hygiene and safety.

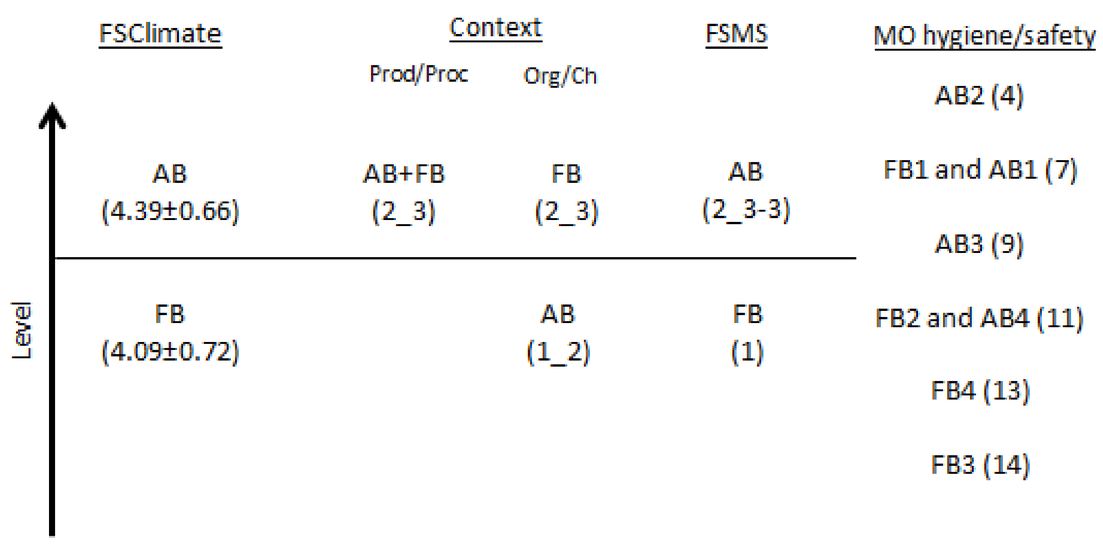

Figure 3: Relative ranking of the eight butcheries included in the case study for their food safety climate, context riskiness, food safety management system (FSMS), system output and microbiological (MO) hygiene and safety. AB: all affiliated butcher shops; FB: all farm butcheries. Prod/Proc: product and process related context characteristics; Org/Ch: organization and chain related context characteristics. Between parentheses mean and standard deviation are given for the food safety climate score (1→5), assigned scores for context, FSMS (0→3) and overall rank score for microbiological hygiene and safety (4→14).

Conclusion

The case study showed some interesting relations between food safety climate, FSMS status and microbiological hygiene/safety. With the help of our food safety climate assessment tool companies are able to go beyond traditional food safety management and mirror the human dimension in food safety.

The food safety climate was scored significantly higher by the centrally managed butcher shops compared to the independent small scale farm butcheries. Also the microbiological hygiene and safety status of the affiliated butcher shops was on a higher level. The lower hygiene status of the farm butcheries suggests that a good food safety climate may not be sufficient to counteract the lower level of the FSMS.

Important to note here is that the food safety climate scores are perceptions of the individual employees. Therefore, it is possible that butcheries over- or underestimate themselves. Personal characteristics such as conscientiousness, motivation and personal wellbeing (e.g. job stress), can play an important role herein.

Further research

The role of personal characteristics such as conscientiousness, motivation and personal wellbeing (e.g. job stress), in the relation between food safety climate and microbiological hygiene and safety needs to be further investigated.

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